5 SEM TDC PHY M 2

2019

(November)

PHYSICS

(Major)

Course : 502

(Electrodynamics)

Full Marks : 60

Pass Marks : 24 /18

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following : 1×6=6

(a) In electromagnetic wave, the rate of energy transmitted across a unit area perpendicular to the direction of flow, is

(i) $S = \frac{(E \times B)}{\mu_0}$

(ii) $S = \frac{(E \times B)}{2\mu_0}$

(iii) $S = \frac{(E_0 \times B_0)}{\mu_0}$

(iv) $S = \frac{(E_0 \times B_0)}{2\mu_0}$

(b) The relation of the induced electric field generated by a changing magnetic flux is called

(i) Gauss' law for electric field

(ii) Gauss' law for magnetic field

(iii) Faraday's law of induction

(iv) generalized Ampere's law

(c) The coefficient of transmission at the interface between two dielectrics is

(i) $T = \frac{(n_1 - n_2)^2}{(n_1 + n_2)^2}$

(ii) $T = \frac{(n_1 + n_2)^2}{(n_1 - n_2)^2}$

(iii) $T = \frac{2n_1 n_2}{(n_1 + n_2)^2}$

(iv) $T = \frac{4n_1 n_2}{(n_1 + n_2)^2}$

(d) In a good conductor, the phase difference between E vector and H vector is

(i) 180°

(ii) 90°

(iii) 60°

(iv) 45°

(e) A rod has a length of 1 m. It is moving in a spaceship with a velocity of $0{\cdot}4c$ relative to the earth. The length as measured by an observer on spaceship is

(i) 1 m

(ii) 0·4 m

(iii) 1·4 m

(iv) $\frac{1}{0{\cdot}4}$ m

(f) Which of the following waves can be considered as circularly polarised wave?

(i) $E_x = E_2 \cos(\omega t - kz),\ E_y = 0$

(ii) $E_x = E_2 \cos(\omega t - kz),$
$E_y = E_2 \cos(\omega t + kz - \frac{\pi}{2})$

(iii) $E_x = E_3 \cos(\omega t + kz),\ E_y = E_3 \cos \omega t$

(iv) $E_x = E_4 \cos(\omega t - kz),$
$E_y = E_5 \cos(\omega t + kz)$

2. Answer the following in brief : 2×6=12

(a) Describe briefly the term 'displacement current'.

(b) In the context of electromagnetic waves in a conducting medium, what are the factors on which the skin depth depends?

(c) Write down the Maxwell's electromagnetic equations in differential and integral form.

(d) Describe the failure of Galilean transformation.

(e) What do you mean by Poynting vector? Explain the significance of the Poynting's theorem.

(f) Write down the boundary conditions to be satisfied by electromagnetic waves across a boundary.

3. Show that the total power radiated by an accelerated charge particles at low velocity is

$$P = \frac{1}{4\pi\varepsilon_0}\left(\frac{2e^2a^2}{3c^3}\right)$$

where the terms have usual meanings. 5

Or

Find out the power radiated by an oscillating electric dipole and describe its angular distribution. 5

4. State Maxwell's equation for a system of charges and currents. Show that energy density of electromagnetic field is given by

$$u = \frac{1}{2}\left(E_0{}^2\varepsilon_0 + H^2\mu_0\right)$$ 4

5. Describe Fresnel's equation for the propagation of light in crystalline media on the basis of electromagnetic theory. 5

6. Using Maxwell's equations, describe the propagation of electromagnetic waves in a non-conducting medium. 4

7. *(a)* Discuss the phenomenon of total internal reflection on the basis of electromagnetic waves. 4

(b) Derive the equation for phase velocity of electromagnetic wave propagating in conducting medium. 5

8. *(a)* State the postulates of special relativity and deduce from them the Lorentz transformation equations. 2+4=6

(b) Derive Einstein velocity addition rule. 4

Or

Define proper and non-proper intervals of space and time. 2+2=4

9. Derive the expression for the kinetic energy of a relativistic particle; hence deduce the Einstein mass energy relation. 3+2=5

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